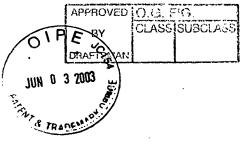
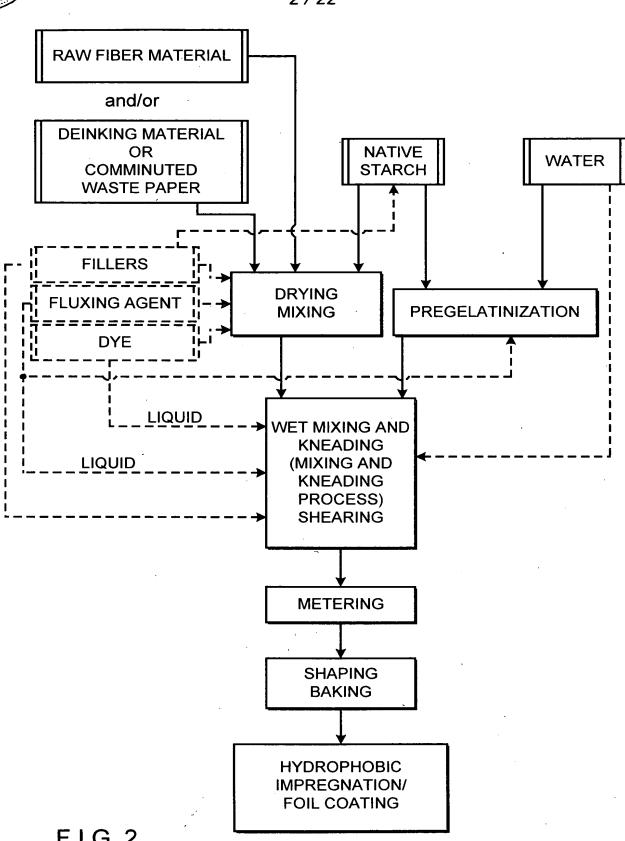
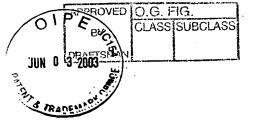


F I G. 1





F I G. 2



3/22 **RAW FIBER MATERIAL** PRODUCTION WASTE and/or CONTAINING OTHER **BIODEGRADABLE PAPER BEET** WOOD PULP **FIBERS PULP CHIPS** (CELLULOSE FIBERS) DETERMINE LENGTH OF FIBERS/ FIBER BUNDLES (GRADING) **DETERMINE STARCH PORTION NATIVE STARCH DRYING FLUXING AGENT** WATER **MIXING** PREGELATINIZATION DYE LIQUID **WET MIXING** AND KNEADING LIQUID (MIXING AND KNEADING PROCESS) **METERING** SHAPING **BAKING HYDROPHOBIC** IMPREGNATION/ **FOIL COATING** F I G. 3

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\ 4				×	X ₅	×°	X ₇	×	×	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅
	47	2 47	47		56,4	65,6	75	84,3	93,3	102,9 112,3	112,3	122	131,4	131,4 140,8	150

X₁₋₁₅ test sample

a in wt. % native starch

b = 250 wt. % water (in relation to dry mass of fiber material)

c = 100 wt. % fiber material

F I G. 4a



c	_	
Č	3	
<u>ہ</u>	₹	
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	y15		75
	y14		150
	y10 y11 y12 y13 y14 y15		225 244 283 281 300
	y12		281
	y11	•	283
	y10		244
	6ά		225
	y6 y7 y8 y9		3 206
	у7		188
	уб		169
	у5		13 131 150 169
	уз у4 у5		131
	у3		113
•	у2		84
	J)		25
	test sample		а

a = native starch in percent by weight

b = 500 wt. % water in relation to fiber material (dry substance)

c = 100% fiber material

F I G. 4b

6	/	22
•	•	

X ₁₅	150	20	200
X 14	140,8	46,9	187,7
	131,4 140,8	40,7 43,8 46,9	162,7 175,2 187,7
X ₁₂ X ₁₃	122	40,7	162,7
X ₁₁	112,3	37,7	150
X ₁₀ X ₁₁	93,3 102,9 112,3	34,9	137,8
×	93,3	28,3 31,3 34,9	112,7 124,7 137,8
×	84,3	28,3	112,7
X ₇	75	25	100
×°	65,8	21,9	87,7
X ₅	56,4	18,8 21,9	75,2 87,7
×	47	15,7	62,7
×3	37,3	12,7	50
χ^2	28,2	9,1	37,8
×	18,7	6,3	24,9
	Ø	р	9

X₁₋₁₅ test sample

a in wt. % native starch

d in wt. % pregelatinized starch

e in wt. % total starch

b = 250 wt. % water (in relation to dry mass of fiber material)

c = 100 wt. % fiber material

F I G. 5a

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ratios

test sample										,				•.	
) y1	y2	у3	y4	y5	ye	y7	у8	у9	y10	y11	y10 y11 y12 y13 y14 y15	y13	y14	y15
e	25	94	113	113 131 150 169 188 205	150	169	188	205	225 244	244	283	261 300 150 75	300	150	75.
р	75	31	38	44	20	58	63	69	75	81	98	94	100	100 100 100	100
	20	92	100	100 125 150 175 200	150	175	200	225	250 275	275	300	300 325 350 375 400	350	375	400

a = native starch in wt. %

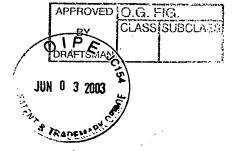
d = pregelatinized starch in wt. %

e = total starch in wt. %

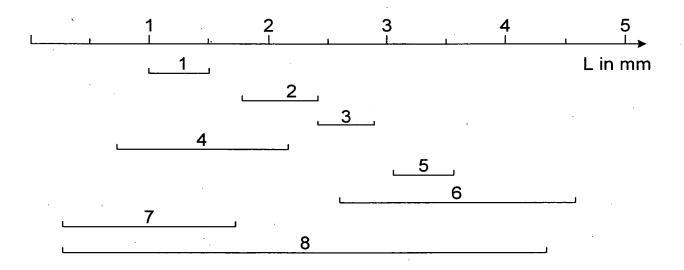
b = 500 wt. % water in relation to fiber material (dry substance)

c = 100% fiber material

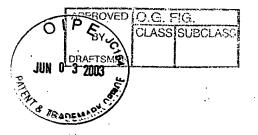
FIG. 5b

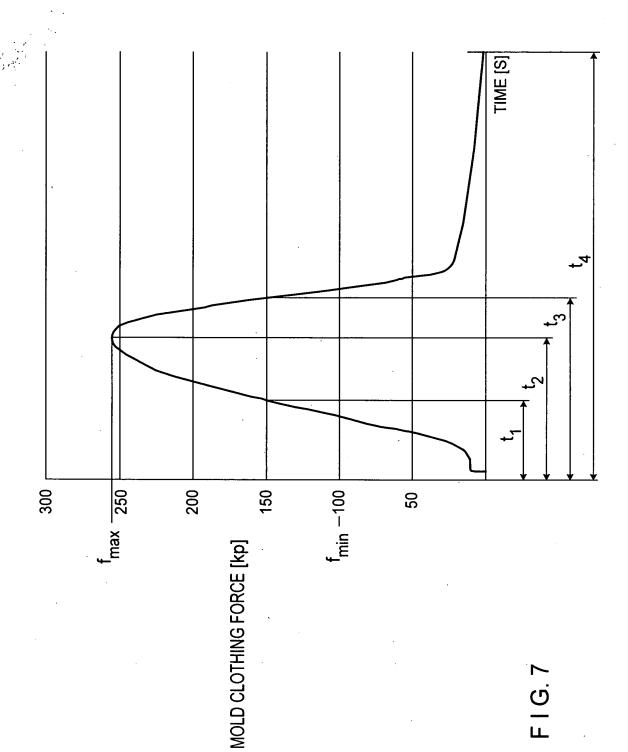


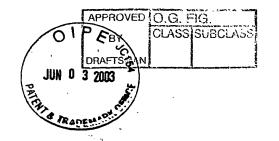
	<u> </u>
Grade	Long fibers/ fiber bundles [mm]
1	0.96 - 1.44
2	1.92 - 2.40
3	2.40 - 2.88
4	0.72 - 2.16
5	3.06 - 3.57
6	2.55 - 4.59
7	0.24 - 1.68
8	0.24 - 4.32



F I G. 6







Use of fibers (fiber bundles) graded by fiber length according to Fig. 6

	∞	1	+	+		8	+	+
	7	+	+	+		7	+	+
	9	+	+	+		9	+	+
E	2	+		1	E	5	+	ı
= 50 mm	4	+	+	+	> 80 mm	4	+	+
11	က	+	١	ı	^	3	+	ı
	5 .	+	ı	1		2	+	ı
	-	+	'	1		_	+	•
					,			
-	80	'	+	+	·	8	+	+
	7	+	+	+		7	+	+
	9	1	1	+		9	+	+
٦	2	+	,	1	E	2	+	-
=30 mm	4	+	+	+	= 80 mm	4	+	+
H 3	က	+	ı	ı	<u> </u>	က	+	ı
	2	+		ı		2	+	1
	←	+		1		-	+	· •
mold depth	fiber length	surface/ texture	strength/ stability	elasticity/ structure	mold depth	fiber length	surface/ texture	strength/ stability

FIG. 8

+ molded body according to requirements- molded body not according to requirements

elasticity/ structure Use of fibers mixtures of different fiber length according to Fig. 6

	9 + 8	+	11/2	22		
> 80 mm	7 + 2 + 6 8	1	+	+	45 : 55	0,3 : 1
	8	+	+	+		
= 80 mm	7 + 2 + 3 + 5	1	+	+	50 : 50	0,4 : 1
	8	+	+	+		
nm	4 + 2 + 3	+	+	•	55 : 45	
= 50 mm	7 + 2 + 3	1	+	+	22	0,4
= 30 mm	4 + 2	+	+	+	60 : 40	. 1
= 30	7 + 4	ı	+	ı	09	0,4
mold depth	combination of fiber length according to Fig. 6	surface/ texture	strength/ stability	elasticity/ structure	fiber material/ starch	starch/water

+ molded body according to requirements

- molded body not according to requirements

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in wt. %	X X X	$\frac{1}{2}$	׳	×	×	×°	X	×	×°	X ₁₀	X	X ₁₂	X ₁₃	$X_3 \mid X_4 \mid X_5 \mid X_6 \mid X_7 \mid X_8 \mid X_9 \mid X_{10} \mid X_{11} \mid X_{12} \mid X_{13} \mid X_{14} \mid X_{15} \mid X_{1$	X ₁₅
fiber material to total mass	26,7	26,7 25,8	25	24,2	23,5	22,8	25 24,2 23,5 22,8 22,2 21,6 21,1 20,5	21,6	21,1	20,5	20	19,5	20 19,5 19	10,6 18,2	18,2
total starch to total mass	9,9	6,6 9,7	12,5	15,2	17.7	20,1	12,5 15,2 17.7 20,1 22,2 24,3 26,2 28,2	24,3	26,2	28,2	10	11,7	33,4	10 11,7 33,4 34,9 16,3	16,3
water to total mass	66,7	66,7 64,5	62,5	9'09	58,8	57,1	52,5 60,6 58,8 57,1 55,6 54,1 52,7 51,1	54,1	52,7	51,1	20	48,8	47,6	50 48,8 47,6 46,5 15,5	15,5
pragelatinized starch to total mass	1,6 2,4	2,4	3,2	3,2 3,8 4,4	4,4	ری	5,5 6,1 6,6 7,1 7,5 7,9 8,4 8,7	6,1	9,9	7,1	7,5	6'2	8,4	8,7	တ

A₁₋₁₅ test sample

F | G 10



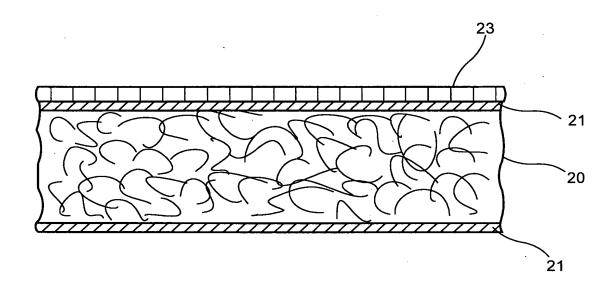
Percent by weight in mass

in wt. %	y1 y2	y2	у3	y4	y5	ye	у7	у8	96	y10	y11	y12	y13	y3 y4 y5 y6 y7 y8 y9 y10 y11 y12 y13 y14 y15	y15
fiber/mass	14,3	14,3 13,8	I `	12,9	12,5	12,1	11,8	11,4	11,1	10,8	10,5	10,3	10,0	13,3 12,9 12,5 12,1 11,8 11,4 11,1 10,8 10,5 10,3 10,0 11,8 12,9	12,9
total starch/ mass	14,3	17,2	20,0	22,6	25,0	27,3	29,4	31,4	33,3	35,1	36,8	38,5	40,0	14,3 17,2 20,0 22,6 25,0 27,3 29,4 31,4 33,3 35,1 36,8 38,5 40,0 29,4 22,6	22,6
pregelatinized starch/mass	10,7 4,3	4,3	5,0	5,6	6,3	9,9	7,4	7,9	8,3	8,8	9,2	9,6	10,0	5,0 5,6 6,3 6,6 7,4 7,9 8,3 8,8 9,2 9,6 10,0 11,8 12,9	12,9
water/mass	71,4	0,69	68,7	64,5	62,5	8,09	58,3	57,1	55,6	54,1	52,8	51,3	50,0	71,4 69,0 68,7 64,5 62,5 60,8 58,3 57,1 55,6 54,1 52,8 51,3 50,0 58,8 64,5	64,5

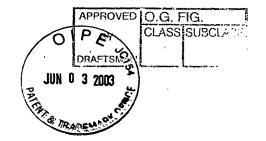
y1-15 = test sample

-1 G. 11





F I G. 12



Trays dimensions 112 x 200 x 17.5 mm

Pots dimensions ϕ 125 mm, vol. 500 ml, height 76 mm

Recipe: Y14

Coating: cellulose acetate (CA)

TS: 4.5% - 15 wt. % dry substance in spray solution

η: 20 - 4000 mPas (viscosity)

Application: spraying, casting, dipping

Layers: 1 - 3 (quantity)

Solvent: acetone

Shape	Thick- ness	Coating	Method	water 100ºC 1h	Resistance oil (cold) 3 days	water (cold) 3 days
pot	89 μm	3.8 g	casting	+	+	+
tray	79 μm	2.3 g	casting	+	+	+
pot	65 μm	2.8 g	spraying	+	+	+
tray	68 μm	2.0 g	spraying	+	+	+
tray	58 μm	1.7 g	spraying	+	+	+
pot	34 μm	1.5 g	spraying	-	-	-
tray	27 μm	0.8 g	spraying	-	-	-



Trays dimensions 112 x 200 x 17.5 mm

Pots dimensions \$\phi\$ 125 mm, vol. 500 ml, height 76 mm

Recipe: Y14

Coating: cellulose acetate propionate (CAP)

TS: 9% - 20 wt. % dry substance in spray solution

η: 200 - 6000 mPas (viscosity)

Application: spraying, casting, dipping

Layers: 1 - 3 (quantity)

Solvent: acetone

Shape	Thickness	Method		Resistance	
			water 100ºC	oil cold	water cold
			1h	3 days	· 3 days
pot	88 μm	casting	+	+	+
tray	88 μm	casting	+	+	+
pot	58 μm	spraying	+	+	+
tray	70 μm	spraying	+	+	+
tray	56 μm	spraying	+	+	+
pot	33 μm	spraying	-	-	-
tray	22 μm	spraying	-	-	

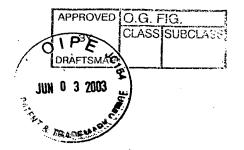


Trays dimensions 112 x 200 x 17.5 mm

Pots dimensions ϕ 125 mm, vol. 500 ml, height 76 mm

No.	Foil	Thick- ness	Deep- drawing quality in	Deep- drawing	R	Resistanc	e water
			tray	quality in tray	100°C	oil cold	cold
1	polyester	100 μm	+	-	-	+	+
'	amide	150 μm	+	-		+	+
2	polyester	70 μm	+	-		+	+
3	polylactic acid	50 μm 100 μm	.	· •		+	+
	(rigid)	100 μπ		-		+	+
4	polylactic acid (elast.)	50 μm 100 μm	+ +	+	+	+	+

Foil	Melting point
1	approx. 120°C
2	approx. 85°C
3	approx. 115ºC
4	approx. 130°C



Cellulose acetate / Cellulose acetate propionate

		Softener	Softener 10 - 30 wt. %		
	Diethyl - phthalate	Triacetin	Tributyl citrate	Acetyl tributyl citrate	Without
CA	+ H / + A	+ H / + A	- HÌ/- A	-H/-A	ОН
CAP	CAP V + / H +	+ H / + ^	+ H / + A	+ H / + A	+ I

+ = good o = medium

Key:

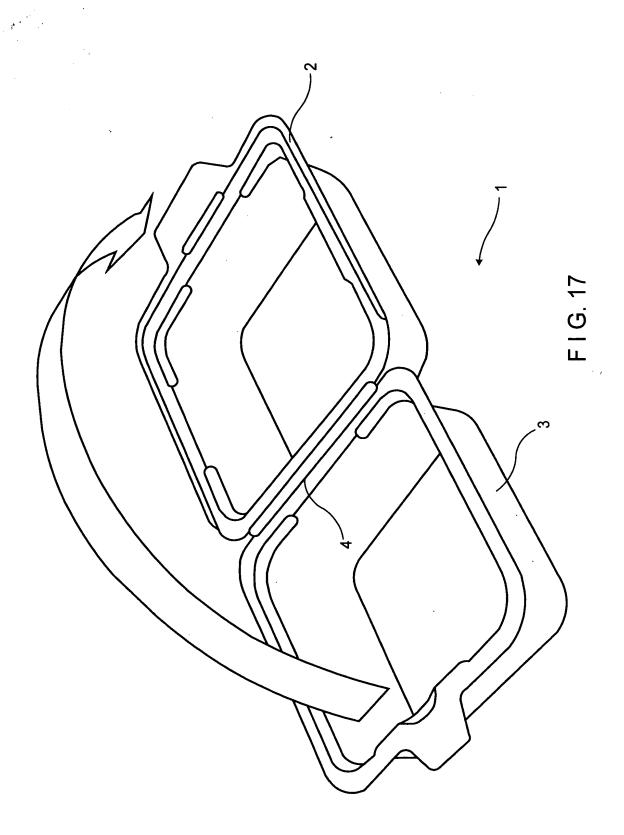
V = compatibility

H = adhesion

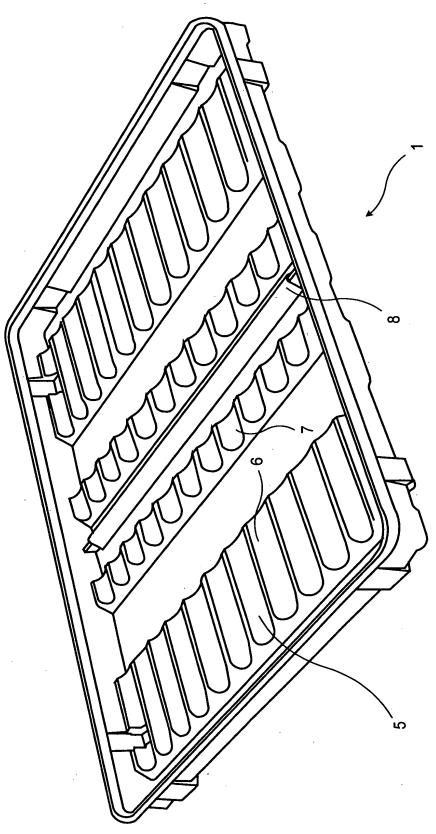
- = poor

F I G. 16

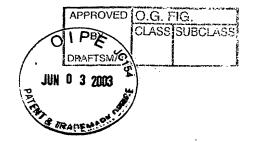
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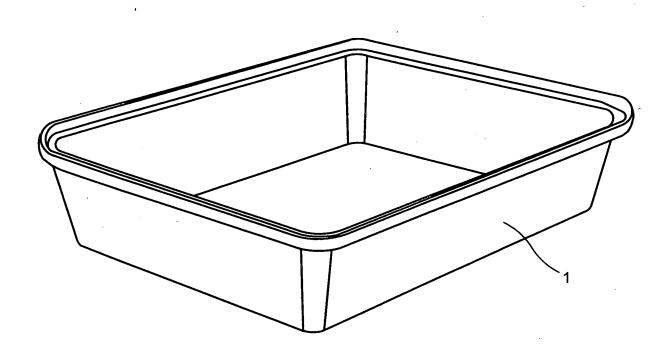






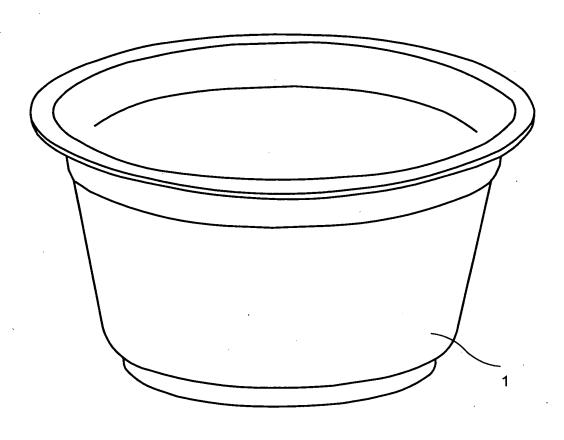
F G. 18





F I G. 19

k



F I G. 20